

REVIEW OF THE WORLD MARKET OF AGRICULTURE ROBOTICS. Part 1. Unmanned Vehicles for Agriculture

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Abstract. The overview is presented of the world market of unmanned aerial vehicles (UAVs) in terms of their use in agriculture. The main tasks of agriculture are described that can be solved by using the UAVs. Conclusions are made about the advantage of the UAVs when compared to satellites and small aircraft. The developments of the main players of the UAV market are given with brief description of the technical characteristics of the vehicles and the technologies of their work. The world experience of the use of UAVs in cattle breeding, plant growing (including that in pest control and chemical applications) is presented. The main advantages and prospects of using UAVs in agriculture are highlighted. The overview is given of such an area of robotics as the robotic farming. The technologies of full robotization of farms are described and existing global projects of urban farms and robo-farms are presented for consideration. The advantages and disadvantages of these technologies are considered. Conclusions are made about the effectiveness and the promises of the introduction of UAV technologies and robo-farming in agriculture.

Keywords: UAV, robo-farm, agriculture, robotics market.

SYNTHESIS OF DISCRETE MODAL SISO CONTROLLERS BY ENGINEERING PERFORMANCE INDICES

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Abstract. The linear discrete minimum-phase plant with one control input, one measured output and with an unmeasured external disturbance is considered. The problem is stated of the design of the discrete output controller that provides the preset engineering performance indices: control error, settling time, stability margins radius. Analytical formulas are obtained that allow to relate the engineering performance indices with the desired closed system characteristic polynomial roots in the modal control problem when choosing real non-negative roots. At the same time, the specified control error and the settling time lead to the constraints on the maximum absolute value of the desired roots, while the values of the desired roots, providing the given radius of stability margins, may not satisfy these constraints, so the specified values of the performance indices should be revised. Examples are given showing the effectiveness of the approach proposed. (P. 11–21)

Keywords: discrete linear system, modal control, control error, settling time, stability margin radius.

ADAPTIVE-ROBUST STABILIZATION OF INTERVAL CONTROL SYSTEM QUALITY ON A BASE OF DOMINANT POLES METHOD

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Abstract. The paper is dedicated to a development of methods of synthesizing linear adaptive-robust controllers of low order, which allow providing constant values of control quality indices. To stabilize systems' dynamics, it is proposed to place allocation areas of system poles according to pole dominance principle. Dominant poles allocation in certain points of complex plane is reached by adjusting some of controller parameters; reduction of other poles' influence on the control quality is reached by choosing constant values for other parameters of the controller. The paper proposes the synthesis method combining advantages of adaptive and robust approach to synthesizing control systems with interval parameters. It is noted that to apply the method proposed, it is necessary to obtain linear mathematical model of the system in the form of characteristic polynomial with integral coefficients and to adjust the parameters of controller, it is necessary to obtain transient values of interval parameters. (P. 22–31)

Keywords: adaptive control, robust control, interval parameters, parametric uncertainty, synthesis, simulation modeling.

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BASIC ORGANIZATIONAL CONTROL MECHANISMS APPLICABILITY AT DIFFERENT STAGES OF INTEGRATED ACTIVITY

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Abstract. The work done is devoted to the research of the applicability of the known mechanisms of organizational systems control for integrated activity (IA) management. For this purpose, the establishment is performed of the correspondence between the various control mechanisms and those phases, stages and steps of the IA on which they could and/or should be used; the completeness is analyzed of the set of existing control mechanisms. Such systematization allows to quickly select and apply an adequate control mechanism while managing the particular activity. The conclusion is made as a result of the work that the mechanisms of organizational control generally could and should be used to manage an integrated activity. However, IA comprises organizations as subjects of activity and therefore represents a wider class of objects. Therefore, the IA managing toolbox is not limited to known organizations' control mechanisms: the advanced IA stages related to the activity specification are covered with control mechanisms much better than the initial ones, when the activity design is performed. (P. 32–40)

Keywords: integrated activity, stages of integrated activity, control mechanisms.

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METHOD OF CONNECTED PROJECTIONS AND ITS USE FOR VISUALIZATION OF MULTIDIMENSIONAL DATA

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Abstract. The method of the connected projections is suggested providing the visualization on the plane of the multidimensional data in the form of geometric objects – polygons and broken lines. One more new tool

is added to standard means of multidimensional data visualization – the introduction of the visualization plane heterogeneity. The model of the connected projections consists of the quadrants of the same size that are connected in a special way. The located in each quadrant two-dimensional projections of a multidimensional point are connected, forming polygons or broken lines. The analysis of the existing methods of multidimensional data visualization is given and the set of rules for the construction of models of the connected projections is provided. Some quantitative and algebraic properties of the introduced geometric objects are investigated. The main advantages of the method and the features of its computer implementation are listed. The peculiarities are given of using the method for the visualization of multidimensional matrix models in solving the problems of strategic planning and for the visualization of multicriteria alternatives in solving the problems of multicriteria optimization. (P. 41–51)

Keywords: multidimensional data visualization, method of connected projections, polygons and broken lines, strategic region management, matrix models, multicriteria optimization.

TWO-STAGE PLANNING TASKS FOR THE FLOW LINE

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Abstract. The problem is formulated of constructing schedules of the two-stage processing of large number of products on two machine systems arranged into a sequential chain, keeping the same sequence for all products. The number of machines at each stage of processing can be different. None of the operations performed allows for interruptions during its execution. Post-processing time losses after completion of the 1st stage of manufacturing are also taken into account. As the optimality criterion, the implementation of the whole range of work in the shortest possible time is considered. Estimates are obtained of the lower bound of the optimal sequence of products processing, ensuring the implementation of all works at two stages of the processing in the shortest possible time. Algorithms are proposed of the exact and the approximate solution of the problem by the branch and bound method and the dynamic programming method, as well as a heuristic algorithm of polynomial complexity for obtaining the approximate solutions. The decision algorithms are illustrated with a numerical example. The results obtained can be widely used in work scheduling systems for the production sectors and workshops of machine-building and instrument-making production, as well as for the processes in woodworking, electronics and light industry. (P. 52–62)

Keywords: two-stage schedules, flow-shop-problem, optimal sequences, branch and bound method, dynamic programming, heuristic algorithm.

STUDY OF THE EFFECTIVENESS OF THE ALGORITHM TO OPTIMIZE THE FLOW OF AIRCRAFT ON LANDING

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Abstract. The problem of aircraft landing sequence optimization is considered. The formal statement of the problem is presented of forming the optimal aircraft queue for landing, the main limitations and target functions. In order to obtain the solution in real time, the methods of optimization of the initial sequence are illustrated and the heuristic algorithm of the approximate solution of the problem is proposed. As the initial sequence for the algorithm to operate, the sequence is selected in that the aircraft land in the order of the

arrival. In the process of applying the algorithm, the initial solution corresponding to the initial sequence cannot be worsened. Computational experiments are carried out in order to study the efficiency of the algorithm proposed. The calculating time and the quality are compared of the initial solution, the heuristic solution obtained using the proposed heuristic algorithm, and the optimal solution obtained using the standard CPLEX package. Noted is that for the problem of large dimension (with large number of aircraft) the optimal solution cannot be obtained, so the heuristic solution is compared with the initial one. Tests for intense aircraft flows are generated randomly. The proposed algorithm allows within a reasonable time either to obtain optimal (30–52% of cases) solutions of the problem or to significantly improve the initial solution. (P. 63–69)

Keywords: aircraft sequences, objective function, optimal solution, heuristic algorithm, computational experiment.

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XIII ALL-RUSSIA CONTROL CONFERENCE (VSPU–2019)

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Abstract. Overall results of the conference, which took place on June 17–20 in the V.A. Trapeznikov Institute of Control Sciences of Russian Academy of Sciences, are presented. The technical program of the conference, as well as brief statistical information, is given. Some interesting results discussed during plenary and section sessions are named. Plenary speakers described the state-of-the-art of modern control science and outlined future directions. Organizers of the invited sessions and round tables in the frame of the conference represented the results of the events. The links to the online version of the Conference Proceedings and to the recorded video of plenary talks are presented. (P. 70–75)

Keywords: conference, control science, technical program, proceedings.